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THE BIRD LOVER AS A SCIENTIST.

By O. G. LIBBY.

The extraordinary growth of interest in nature study in this country has had a marked effect not only on pedagogy and all related subjects but also upon biology and its allied sciences. The investigations of the zoölogists, especially, are being enriched by the labors of a large number of enthusiastic and wholly unrecognized amateurs. In the field of bird study there are many problems that escape the trained zoölogist, familiar only with prescribed routine of manual and laboratory. But the bird lover has at least one advantage over the scientist, he is in touch with the bird on the human side, he sees in this form of animal life the acme of the intellectual and the artistic combined. Where the biologist is scientific, the bird lover is sympathetic.

This gives the latter a considerable advantage, for, while he may acquire the requisite technical skill in order to study his favorite subject more scientifically and still keep his sympathetic touch unimpaired, the scientist can never reach this close relation by the road of the dissecting room and the microscope. It is then to the amateurs, and not to the scientists, as a class, that the teaching world owes much of the new impulse in the direction of bird study. For a student who lays aside his manual and attempts the difficult task of conducting a class in bird study out of doors with living forms for material, there comes a disagreeable surprise on finding out that, after all, our knowledge of birds is exceedingly limited and very inexact. Problem after problem will arise in actual observation for the solution of which there is little or no help to be found in the printed accounts. Take the single case of the color changes in the plumage of the bobolink, the scarlet tan-

ager, the orchard oriole or the redstart. Has any observer yet been able to state just how the transformations take place, when and where? In the case of the orchard oriole and the scarlet tanager the changes extend through a period of nearly three years. One would suppose that if the scientists who study fish and reptiles could have the patience to count the scales for the different species, that some scientist would have undertaken the task of counting the feathers for the different species of birds. Yet if this were seriously proposed at a meeting of scientists, there is no doubt but that it would be laughed at. We may hope, sometime, to see the amateur, whose time is of no value, take pains to count the feathers on the different species of common birds and carefully tabulate them by the various feather tracts of the skin, making a separate study of the varying proportions of colored to uncolored feathers. The value of the results reached will then be recognized by the scientist and the study will be pushed to its logical outcome.

When this is done we shall know, as we cannot now, the effect of climate, food and locality upon a bird's feathers, both as to number and texture. This will, perhaps, supply the most effective means of determining whether our winter birds migrate and whether those we see here during January are from the north. In the problems of evolution, this feather counting would give a means of ascertaining exactly how far individual variation could proceed within the limits of the species and along what lines of feather development this variation proceeds.

Wallace has pointed out that among individuals of the same species of birds there is great diversity in the measurements. Following this suggestion the writer made a careful study of one species, the common red winged blackbird. Twenty-four measurements were taken for each bird and about sixty birds were measured. The accompanying plates indicate the range of the diversity, in twenty of the whole number measured. Eight sets of measurements were selected and the table below indicates the character of these measurements.

TABLE I.

- I. Length of intestine.
- II. Extent of wings from tip to tip.
- III. Length of body from end of beak to tip of tail.
- IV. Length of wing.
- V. Length of esophagus.
- VI. Length from clavicle at tip of breast-bone to the cleft of the lower mandible.
- VII. Length of tail.
- VIII. Length of head.

If these sets are compared it will be seen that no one bird exceeds in all but rather that each bird has some noticeable proportion of measurements which differentiates it from all others. In some the tail or wing, is longest, in others the body or head. Whatever the particular environment calls for in the evolution of new habits or characteristics is thus to be found in some of the individuals of a medium sized flock. The fittest that survive are the ones who possess among other things that peculiar proportion of measurements which adapts it to the new demands of food-getting or escape from enemies.

An excellent illustration of this partial evolution of a species from the habits and proportions of one family into another totally different is to be found in the warbler family. The black and white creeper has lost a large number of his original warbler characteristics and has taken on those of the woodpecker. This appears in the color, in the lengthened beak, the flattened body, and in the method of locomotion. A still better illustration is the Louisiana water thrush. This bird frequents the banks of streams, and gets its food after the fashion and in the same places as does the snipe. As a result the color is a fair imitation of that of the snipe, both above and below; the beak is longer and the body is larger than that of the average warbler and its habit of flying up to a low bush or overhanging limb when alarmed tells the nature of its enemies. But most characteristic of all, this warbler has the gait of the snipe, even to the tilting motion of the body. From a tiny brilliantly colored acrobat of the treetops there has evolved a plump sober-colored snipe-like creature whose markings and motions are all the results of the new environment.

The variation of proportions in the measurements shown in the plates may not indicate that evolution of other forms is still going on but it certainly points back to a time when species was more flexible and readily developed along whatever line seemed to offer the least resistance. But evidence of variation among individuals of a species may be found outside mere physical characteristics. One of the most enjoyable features in bird study is the song. In this almost wholly unworked field, where there is so much to discover, it has already been pointed out that the amount of individual variation in a given species is sometimes extraordinary. Such well known singers as the field sparrow, the American goldfinch, the song sparrow and the meadow lark furnish examples of this kind of variation.

Thirty-five songs for the field sparrow, and twenty for the song sparrow have been reported, and to any one at all familiar with the vocal performances of these birds, this will not seem at all unusual. White throated sparrows show surprising individual variation in their rather long and characteristic song.

The Baltimore oriole is still another singer of great capabilities and wide range of variation. Indeed the oriole seems to me to make the nearest approach of any of our birds to the sounds in human speech. On the occasion of a wheel trip from Wisconsin to the northeastern portion of Ohio the writer was struck by the local variation in bird songs. The vesper sparrow, for instance, in Ohio, began his song with the two notes of the chickadee's song. The swamp blackbirds were noticeably different, also, and so were the meadow-larks. There is no doubt an opportunity here for some amateur who has the musical training to discover and make use of what has so long lain unknown and unused.

Another interesting question arises in connection with the time when young birds learn to sing. The period of song varies so much with different species that no fixed rule seems to prevail. It is sometimes possible, also, by observing the singers in a given species to ascertain how long it takes for the young males to assume the full male plumage. One illustration will suffice;—a purple finch in female plumage was found singing the full spring song, which would seem to indicate that it takes two years for the species to assume the male plumage. Songs and calls are the language of birds, and by this means all the emotions find expression and thought is conveyed. In the works of Thompson-Seton the language of animals is very cleverly used in a series of charming sketches, and though the author too often calls upon his imagination to eke out his facts, yet there is a sufficiently substantial basis to his tales to make them excellent interpretations of nature. Some years ago the writer assisted on the relief work in a city which had been devastated by a cyclone. The most painful experience that remained after two weeks' work among the horrible debris of the ruined homes was to hear for several mornings at day-break the pitiful song of a Baltimore oriole whose nest, eggs and dead mate were picked up near the house. Since that time the motif of this song has been identified with a very effective strain in a funeral march written by Grieg.

The most marvellous phenomenon in bird life beyond all question is the semi-annual migration. The numbers of the birds, the distance travelled and the dangers and difficulties to be encountered all contribute to make this a notable performance. But, in spite of its importance, bird migration has received comparatively little attention in America. There are three ways in which this movement may be studied. First we may keep note of all arrivals and departures day by day and thus ascertain dates for successive years. If there are observers enough to cover a given region fairly well, a good summary of the whole movement may be worked out. This for

the most part is the only method by which migration has so far been studied. Some reports have been made relative to the destruction of birds at lighthouses, but no one has yet studied migration at these danger points with a view of recording the exact number of species and individuals for every month in the year. From some acquaintance with lighthouse keepers it seems certain that if the government would supply these men with such a manual as Chapman's, many valuable records could be kept by them. Certainly the lighthouse keeper is the most natural observer to be selected to keep account of the loss of life at his station and most of them would do this willingly if they knew it would be of service to any one. Such monuments as the one at Bunker Hill and the Washington monument frequently attract migrating birds in cloudy or foggy weather, small flocks of such birds may often be heard calling about the tops of these structures. Along the Appalachian mountain mass the coke ovens that burn all night also prove attractive to migrants. These ovens throw a broad band of light upwards to the clouds. When the migrating birds reach this light they turn downward and are often found fluttering about the fires by the watchmen there. Those observers who have access to such places as these should preserve a record of those birds that have been deflected from their course by delusive lights.

A second method of observing migration lays emphasis upon the calls of the passing birds, their number, direction and character.

In the fall of 1894 my attention was attracted by the calls of a certain species of birds passing overhead during several nights in middle September. There was an unmistakable family resemblance in these calls as the migrating birds came trooping out from the north, making the spaces of the upper air ring with their mellow calls. Now and then this merry chorus would contain a discordant note of a bird of another species showing that other birds were mingled in the great swarm headed southward. This particular flight continued for three nights, all cloudy and very dark. The line of flight seemed to extend to the westward and to lose itself in the distance.

While such observations appeal to the scientist they have meanings also to the bird lover. There is something weird in these high-pitched calls sounding down out of the upper darkness. They seem to express by turns, fear, doubt, hope or confidence. Sometimes the call is complex and like that of the young rose-breasted grosbeak expresses the first bewilderment of the fledgling, thrust out into unfamiliar surroundings and winging his way amid utter darkness, guided only by the cries of his fellows. But besides the charming naïvete of the mellow

call of this grosbeak, it seems to express also, that light-hearted optimism which sustains the whole bird family during the trials and dangers of their semi-annual flight. One could wish for that knowledge of the language of animals in which Mowgli of the Jungle Stories is so well versed and which Aaron of the Wildwoods teaches to Buster John and Sweetest Susan. With such a gift of understanding, the favored mortal seated beneath the hurrying stream of migrating birds far above him, could translate the myriad sounds into messages marvellous and unique, full of strange adventure and hair-breadth escape, telling of far-away lands and myriads of well-hid nests, of life on the water along solitary beaches or amid the unbroken stillness of the vast pine forest ; messages redolent with perfume of tropical flower jungles, glowing with the fresh eager life of a new spring, overflowing with delight at the long flights over ocean, mountain and wide-spreading plain. Yet this wonderfully tangled mesh of sound that descends upon us out of the sky does not hold us spellbound and mute till the marvel has passed by ; it comes to the busy and indifferent multitude unheeded. Every year over the crowded streets of busy cities float these feathered multitudes, but their loud cries of wonder and fear as they descry the lights below them find few listeners in the hurrying throng. We are so immersed in our bustling existence that the very messages from heaven make no impression upon us. Birds are especially noisy on foggy or rainy nights. On several occasions during the May migration at Madison have severe thunderstorms caught a large flock of migrants and sent them scurrying down by hundreds all over the city. The piteous cries of these wet and bewildered birds heard amid all the noises of the storm sufficiently express to a sympathetic listener their utterly disconsolate condition. One might almost imagine them to be a train load of drowsy but indignant travellers spilled out of their comfortable places by an accident and seeking by devious and unpleasant ways the dubious hospitality of a near-by village.

A detailed observation of the calls of birds during the night was made Sept. 14, 1896, at Madison on a small elevation southwest of the city. The sky was clear, there was no moon, and a raw southeast wind was blowing. The total number of calls counted between ten and three o'clock was about thirty-eight hundred, or an average of twelve per minute. As in 1894, the mass of sound seemed to lie toward the west, which would make the general direction of flight from northeast toward the southwest. Though the observation extended from ten till a little past three the calls began much earlier in the evening and kept up long after four. A great variety of birds passed

overhead during this evening and in all sorts of groups or flocks. Sometimes the lines of birds would seem to extend for more than a mile in perfect formation, as indicated by the regular calls up and down the whole line. At other times smaller squads of more swiftly flying birds would dash by overhead keeping up the compact formation with the precision of trained cavalry.

This method of observing bird migration is not difficult and it has the great advantage of being open to every one. The best time to observe is in May and September, and cloudy or foggy nights yield the best results. It is possible, nevertheless, to hear the calls of passing birds as early as the latter part of August and they do not cease even into November. As late as Thanksgiving, in the latitude of St. Paul, Minn., a large number of calls were recorded between nine o'clock and midnight. Regular observations covering a month each year, even if limited to a single hour in the night, would soon come to have a great scientific value. In a subject so little studied, every one is a discoverer and all observations are of value if made with care.

One valuable conclusion was reached by this study of nocturnal flight. It has been repeatedly alleged that captive birds are attacked in the spring and fall by fits of restlessness, which lead them to beat their wings against their cages in vain endeavors to escape. This has been adduced by careless observers as a proof of the migratory instinct. But like most of the facts upon which the hypothesis of instinct rests, this one has been misinterpreted. The captive bird hears the calls of his own species during their semi-annual flights and very naturally tries to escape to join them. The duller human hearing of his captors entirely misses the sounds which to him are full of meaning, and his efforts are considered as proving the existence of a blind impulse termed instinct.

A third method of studying migration consists in observing the birds as they pass across the face of the moon. In this method a small telescope is necessary or a good surveyor's instrument. In this way it is very easy to take leisurely observations of a very wonderful phenomenon. The birds are visible on the disc of light from one-tenth to one-third of a second for the rapid flyers and for the slower ones they are sometimes visible two or three seconds. The first record made was during the nights of September 11, 12 and 13, 1897. The telescope used belonged to the Washburn Observatory and was a small six-inch instrument. A total of five hundred and eighty-three birds were counted in the three evenings which, it was estimated by Prof. A. S. Flint, represented 168,000 birds passing Madison within range of the telescope. This will give some

faint idea of the nature of the movement a portion of which passes under one's eye in so short a space of time. The first conclusion reached by these observations was that the bulk of the birds used but a small portion of the night for flight. Plate III shows graphically at what hour most of the birds are on the wing. The apex of the movement is seen to be attained at 10.30, and in less than an hour later the flight has largely passed. That the record shows birds flying as late as five in the morning indicates, as we should expect, that the different species fly for different lengths of time, the strong-winged birds keeping up their flight much later than those weak flyers. It is also to be noted from the chart that the birds move in waves, passing successively over a given region. This is in harmony with observations taken by every other method and is indeed one of the better known facts about bird migration. It was further observed that the birds did not all take one direction, but it was not until several years later that other records were placed with these and a satisfactory conclusion reached. From plate IV is seen indicated the direction of flight for each bird across the moon's face; the more heavily shaded portion of the line being that portion of the field at which the bird passed out of sight. If the predominant direction of flight for August and September be compared it will be noticed that they are at right angles to each other, and it will be seen further, from the principal directions of flight in the spring, that the flight in May corresponds in direction to that in September while that in April corresponds to that in August. Whatever astronomical errors may have been made in reducing the directions across the moon to earth directions, it still remains a fact that in the spring and fall there are two well defined lines of flight at right angles to each other and that the later one in the spring corresponds to the one in September. Different directions in flight mean different routes, and this would seem to indicate different species of birds and to suggest a variety of routes to correspond with the great differences in point of wing-power, food, enemies and intelligence among the large number of species that migrate. The migration thus becomes an immensely complicated process having all possibilities for individual or species variation which is afforded by any other of the vital activities in bird life. A further study of the figures in the plate will show that in each of the months there is evidence of birds of another month. For instance, in the figure showing directions of flight for May will also be seen a considerable number of lines having the direction which was found to be the predominant one in April, and this will be found true in every one of the figures in the plate. In other words the May birds begin their flight in their own direction as early as April. We know this

is true from other observation; the myrtle warbler comes early, while the bulk of the warblers come in the middle of May. But still another conclusion may be drawn from the material shown in these figures. While the great majority of the birds followed one general direction there were a considerable number of scattering flights recorded. These undoubtedly represent lost birds who are wandering in every direction seeking their missing comrades. The dotted lines in the figures represent the track of lost birds who changed their course within range of observation. In every case it will be noticed that the dotted line points along some general route as it leaves the circle, indicating that this records the flight of a bird that had wandered away from the flock and was just re-joining his companions or those of his own species.

This evidence of wandering on the part of migrating birds even when there is a full moon serves as a striking proof that it is no mere impulse that drives birds on the long semi-annual journeys. We have seen that birds do wander in cloudy or foggy weather, especially during storms. But here is visual proof that a certain number of them wander out of their course in a great variety of directions. What then becomes of the hypothesis of an unvarying instinct that guides the birds as gravitation holds the stars in their courses? For this theory to be true there ought to be no wandering or lost birds either on clear or cloudy nights. That there are such birds continually present, the records of every observation for the past five years abundantly prove. Only a beginning has been made in the study of the nocturnal flight of birds but it is a subject that promises well for the amateur and will yield the scientist a rich return as soon as he can be convinced it is worth his while.

For the present a few observers are doing the work for the mere pleasure of it. None of those who aided in gathering the material presented in this paper could restrain their exclamations of delight or astonishment as the birds floated leisurely into sight or dashed pell mell across the little circle of light. There was constant evidence of the highest activity and steady purpose in the perpetual come and go of the moving birds, and upon turning the eyes away from this busy scene to the quiet moonlit landscape as it lay in midnight hush outside, the contrast was striking in the extreme. Those who participated in the labor of observation all felt that what had so long remained securely hidden from us, had at last yielded itself to cross-section study of the most approved scientific type. But it was no less a peep into fairy land as well, to watch the tiny hurrying forms flit silently across the charmed circle that rendered them visible to mortal gaze.

The rate at which the birds moved was very much affected by

the wind. Numbers were recorded as seeming to be blown along with hardly an effort, while others sailed, occasionally flapping their wings and apparently borne on by a strong current of air. One bird was noted in particular since it passed slowly *backward* across the moon, evidently too tired to struggle longer against the wind. The identification of the birds seen was not possible in most cases. Gulls and swans were observed at different times as were also ducks and geese. There were identified a large number of swamp blackbirds, some meadow-larks, a night heron, some robins, a night-hawk and a sparrow-hawk. A number of very small birds were recorded as passing "like a shot" and were probably either swifts or swallows. It is claimed that many strong-winged species of birds migrate only by day, but as most of these have been observed through the telescope at night, this theory, also, must yield to the recorded fact.

In view of the continual presence of such birds as gulls, ducks and geese at night, migrating with the rest, their migration by day seems a little hypothetical. While it is true such birds move about a good deal during the day in search of food, there has never been a set of observations in this country which has proved day flight as persistent as it has been demonstrated to be during the night. Nocturnal migration seems to prevail throughout the bird world and for the best of reasons. As the birds move out of their accustomed haunts into new regions, food-getting becomes a serious problem especially since the motive power of flight must be supplied by such food as can be found in a strange land among unknown dangers. Daylight alone would render such search for food safe and certain for the hungry birds whose long flight the previous evening had left exhausted and in great need of refreshment. Night time is better for migration in large flocks since the danger of attacks from hawks and shrikes is greatly lessened. That they see the general configuration of the country is certain, and the stars and moon also guides them as well. Foggy nights, while not interfering at all with a hypothetically perfect instinct of direction, do make it hard for birds to find their way since they have not the infallible guide which it is fabled that they possess. Great physical features like river valleys, mountain ranges and coast lines are the guide lines of bird migration, and at their distance above the earth, the whole lies in perfect panorama beneath them as they fly. In this country the fly lines for our birds are the Atlantic coast lines, the Appalachian Mountain mass, the Mississippi River, the Great Lakes, the Rocky Mountain and coast ranges and the Pacific coast. Particular points along these lines are specially dangerous to migrants. The lighthouse at Key West, in Florida,

stands at a place where all the birds from Maine to Georgia pass by as well as those that inhabit the higher regions of the Appalachians. After severe storms at this lighthouse thousands of dead birds lie piled at the base of the tower. Another danger is the lighthouse at Mackinaw Strait between Lake Michigan and Lake Huron. Here are concentrated all the lines of flight from the upper shores of the lakes and from all the interior waters of Canada.

It would render the lighthouses much less dangerous to migrating birds if the lights were changed from the fixed to the alternating form. The keepers at Minot Ledge say that when this lighthouse had a fixed light a large number of the birds flying from Cape Ann to Cape Cod or the reverse were blown inshore and dashed against the tower by the strong northeast gales. Now that the light is an alternating one, the birds are able to avoid it when they are driven in by a storm and so escape death. Another fruitful source of disaster to migrating birds is the old-fashioned electric tower or mast which places a light or a group of them high in the air above the city. For lighting purposes they are quite useless but they will remain a menace to birds till they finally give way to more modern and less expensive modes of lighting.

Observation of nocturnal migration in the manner described, and records of the number and kind of birds killed at coke ovens, tall monuments, lighthouses, and electric towers will in time form a body of material of the utmost value to the student of bird life. Such facts are worth numberless theories and will help to dissipate much of the pseudo-scientific half-truth which is so prevalent in the popular works and hurriedly prepared manuals. We are just coming to realize how extremely ignorant the best informed are on so fundamental a question as migration. Until the omnipresent scientist occupies this field and drives out the amateurs, there is unlimited opportunity for discoveries of the highest importance; a golden harvest to be reaped by the unpaid enthusiast.

In the economy of bird life, migration plays an extremely important part. As a factor in the evolution of a perfect bird, one best adapted to its environment, migration must ever be considered as holding a high place. No weakling can survive the tremendous strain of the long journey southward from the nesting places into countries all unknown to the thousands of young birds. The stragglers drop out by the way or are picked up by the attendant hawks and shrikes that skirt the flanks and harass the rear of the bird armies, and by spring-time it is the pick and flower of the year's product that find their way safely northward to select the choicest spots and rear their young for the next trial trip. Survival of the fittest has a

meaning in this supreme test of wing power and lung capacity, of courage and prudence and indomitable perseverance. Again, migration serves to scatter and redistribute the various groups of individuals. In this way new feeding grounds are discovered and different species are more widely extended or take possession of more suitable breeding places. This process goes on so thoroughly that in spite of a considerable return of individuals to the same spot year after year, a pretty complete rearrangement of the bird population from the spring and fall migrations certainly takes place. In ten years' observation no year has been quite like any other either in the number of individuals in a given species or in the variety of the species observed. Each year seemed to be distinctive and marked off from all others, and the more complete the record the clearer was the evidence upon this point. An artesian well, sunk in a treeless Dakota prairie, poured its surplus water into a neighboring depression, producing a small lake. It was not three months old before the migrating birds discovered it and made it a stopping place on their way. As time went on and grass and shrubs grew thickly along its edge, the birds took possession of it and it became a populous oasis in a desert. Tall trees and thick undergrowth now mark the spot where the lake lies and it has become the home of hundreds of birds of many species, while from it as a center birds disperse in all directions during the season of migration. If the source of the water should fail the peopling of this spot would cease and the birds would soon learn to avoid the place where water and vegetation were fast disappearing. This is but a single instance of hundreds of similar cases, but it serves to illustrate one of the functions of migration in the economy of nature. In brief it is this that gives to our bird population the extreme of flexibility by which it adapts itself with the utmost ease to the great changes wrought in the face of the country during the past few hundred years. Of all the agents of change and destruction man has been the chief. Since his occupation of America a number of birds have made notable changes in their habits and so have become in a certain sense the companions of man.

The cliff swallows have abandoned the overhanging rocks where they built their flask-shaped nests, and under the eaves of barns they now build shallow saucer-shaped nests, where food is more abundant. The robins and phoebes have taken to living in nests often supported on man-made structures. Even the night-hawks rear their young on the gravel-covered roofs of the Chicago "sky scrapers" and gather their food above the smoke and dust of her streets. The chipping sparrow has now become the *hairbird*, and for a large part of her nest material uses the horse hair which she obtains by means

of her association with man. The warbling vireo and wood pewee have become our common city birds in the parks and along the drives. The only common name of one of our birds has come from the association with our cattle, the well-known cowbird.

In this very brief sketch but a few of the interesting and unsolved problems of bird life have been indicated. There are many more that will instantly occur to every one. It is a matter of encouragement, also, to the unscientific bird lover that he has still most of the field to himself. In this most fascinating study some of the deeper problems of animal life are involved. No one need feel that the subject is unworthy his serious attention. On the side either of science or of the humanities, it is exceedingly rich. Especially are the teachers and students of psychology bound to recognize the possibilities here and make increasing use of them in the future.

PLATE I.

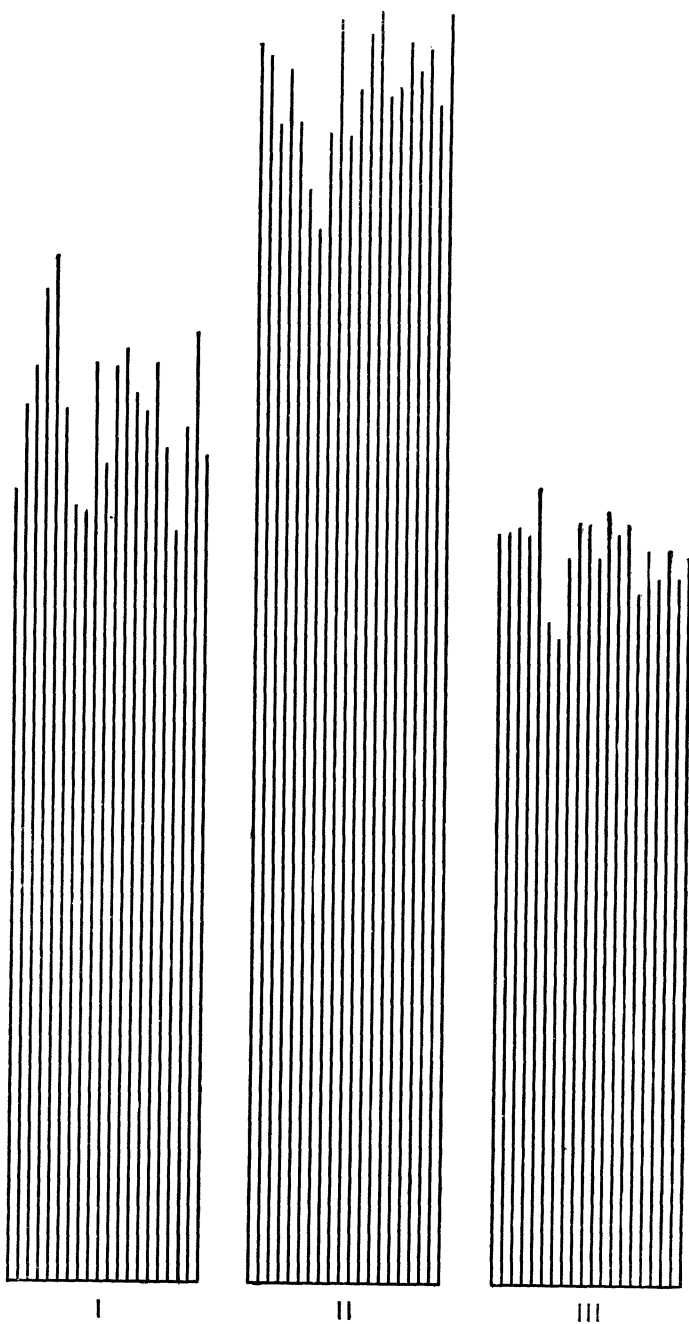
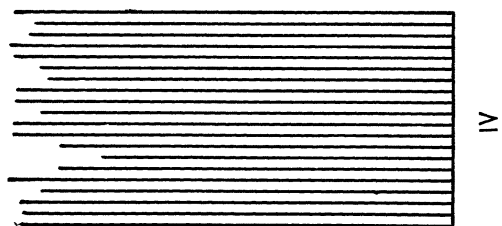
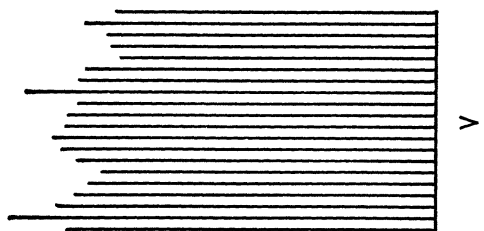


PLATE II.



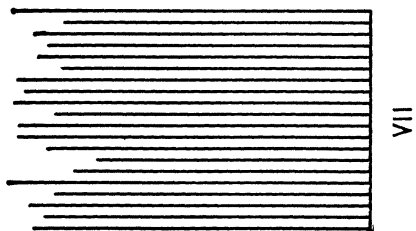
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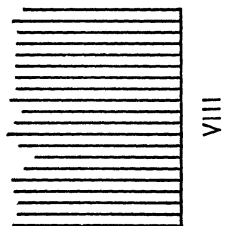
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VI

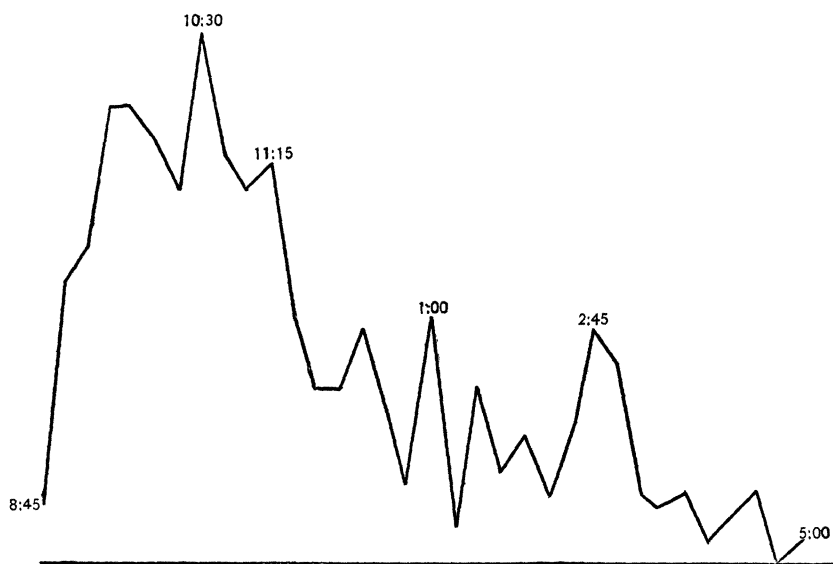


VII



VIII

PLATE III.



Graphic Representation of Number of Birds Observed by 15-Minute Periods.

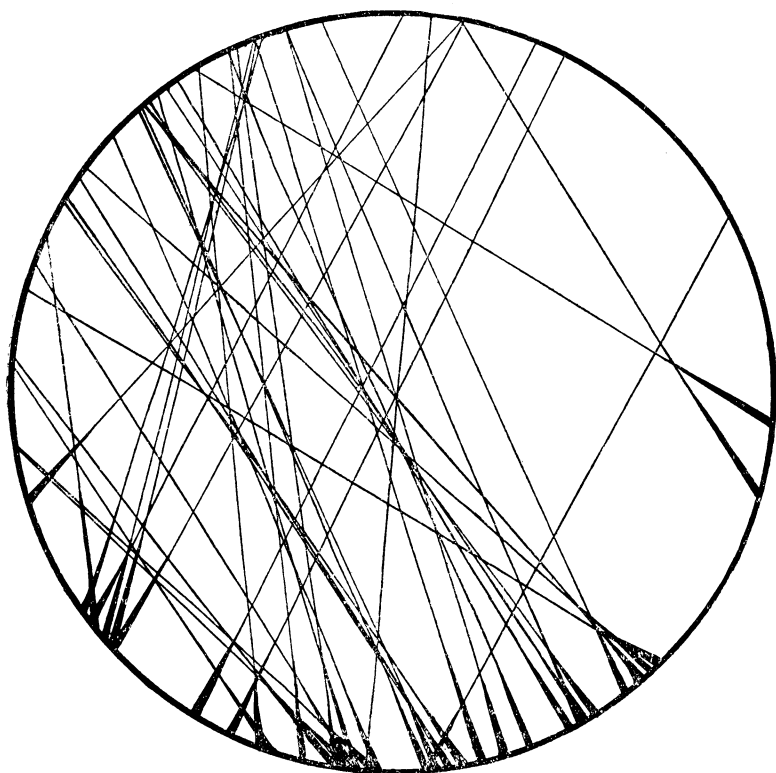


PLATE IV, No. I.
August, 1898.

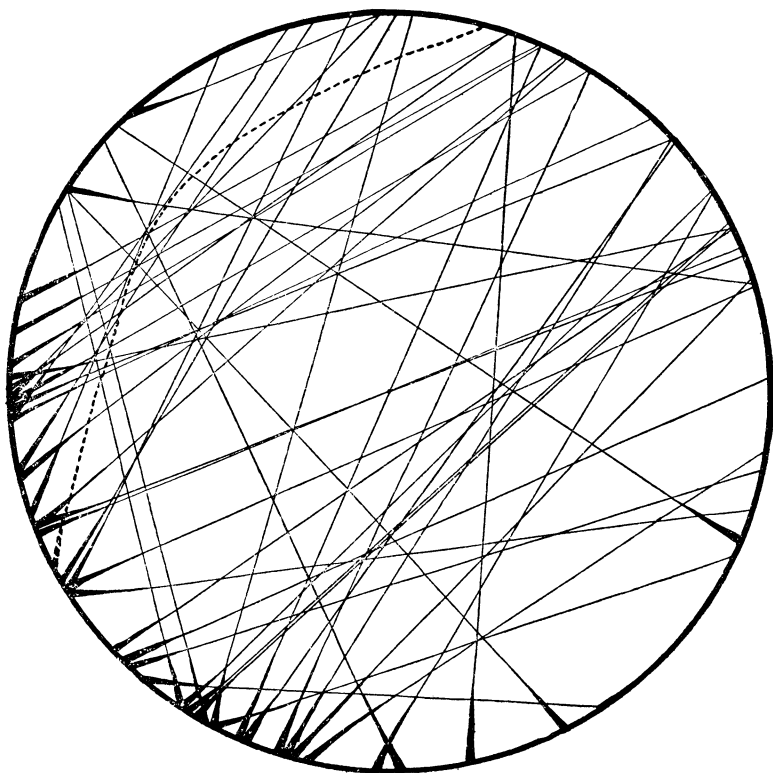


PLATE IV, No. 2.
September, 1899.

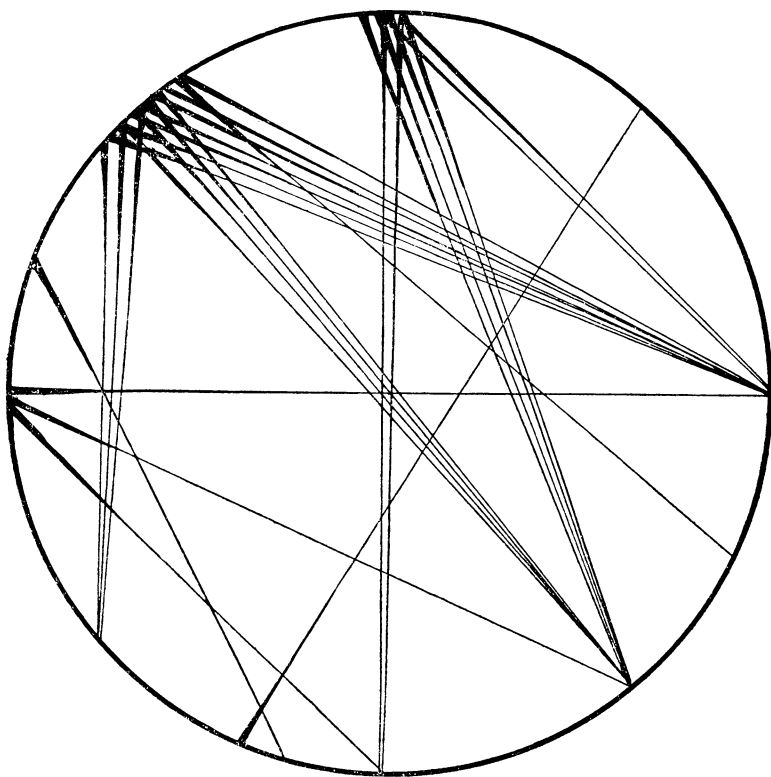


PLATE IV, No. 3.

April, 1899.

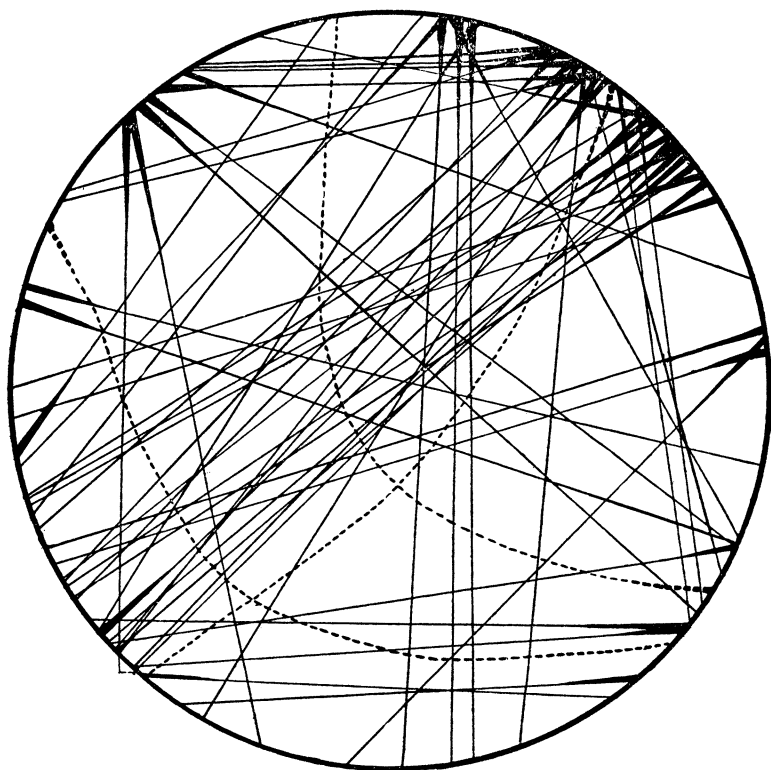


PLATE IV, No. 4.

May, 1899.